ORIGINAL RESEARCH

Current management of patients with ST elevation myocardial infarction in Metropolitan Beijing, China

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Abstract

Purpose: To assess clinical practices and in-hospital outcomes of patients with ST elevation myocardial infarction (STEMI) in Beijing, China.

Methods: This study was a prospective multicentre registry study in Metropolitan Beijing, China. Demographics, delay time, management strategy and in-hospital outcome data were collected from patients with STEMI enrolled in 19 hospitals.

Results: A total of 803 patients (mean age 61±13 yr, 22% women and 42.1% ≥ 65 yr) with STEMI were enrolled. More than half had a history of hypertension (50.4%) and current smoking (55.2%). Six hundred and fifty patients (80.9%) received reperfusion therapy: 124 (15.4%) treated with thrombolysis and 526 (65.5%) with primary percutaneous coronary intervention (PCI). The median door-to-needle time for thrombolysis was 83 min and door-to-balloon time for primary PCI was 132 min. Only 7% of patients treated with thrombolysis met the guidelines goal of the door-to-needle time ≤ 30min and 22% of patients had PCI performed in ≤ 90 min. Aspirin was prescribed in 97.8% of patients, low molecular weight heparin in 92%, statins in 91.0%, β-blockers in 76.7%, ACE inhibitors in 73.5%, clopidogrel in 89.7% and GP IIb/IIIa antagonists in 19.3%. In-hospital mortality was 5.4%.

Conclusion: Recommended Clinical Guidelines treatments are largely implemented in patients with STEMI in Beijing. However, many patients were not reperfused within the

recommended times. There remains important potential for improvement in the administration of reperfusion therapy.

Over the last few years, there have been remarkable advances in the management of patients with acute ST-elevation Myocardial Infarction (STEMI), both in terms of early reperfusion therapy and secondary prevention. Clinical guidelines have provided timely and appropriate decisions for each individual patient with STEMI.^{1,2} Surveys from western countries, however, showed that many patients with STEMI remain “untreated” with limited access to reperfusion therapy and suboptimal utilization of proven pharmacotherapies in clinical practices.³⁻⁵ So far, little information is available about whether and the extent to which recommended treatments have actually been applied to real-life practice of Chinese patients with STEMI.

The purpose of the present study was, therefore, to determine time delays, management strategies and in-hospital outcomes as well as the adherence to current guidelines in consecutive patients with STEMI in metropolitan Beijing, China.

Methods

Patients

All patients gave informed consent. The study protocol was approved by all the 19 Hospital Ethics Committees.

This prospective multicentre registry study was conducted between 1 December 2005 and 31 November 2006. We consecutively recruited 868 patients admitted to the coronary care unit (CCU) at 19 hospitals in Beijing, China. All hospitals were able to provide cardiac catheterization 24 hr/day, 7 days/week. To be recruited for the study, patients needed to be: (1) hospitalized within 24hr of the onset of acute myocardial infarction (AMI) symptoms; (2) diagnosed with acute STEMI.² Patients presenting with the following criteria were excluded: AMI onset occurring after hospitalisation with another clinical presentation, clinical condition did not permit them to be interviewed or if they did not consent to participate. After exclusions, the final sample consisted of 803 patients.

Data collection

Data were collected using a detailed standardized case record form by a trained cardiologist at each centre. Patient demographics, cardiac risk factors and cardiac medical history, clinical characteristics on admission, in-hospital delay time, management strategy and in-hospital outcomes, as well as length of stay in the CCU were recorded for each patient prospectively. In-hospital delay was categorized into door-to-needle time and door-to-balloon time. Door-to-needle time was defined as the time from hospital arrival to the initiation of thrombolytic therapy. Door-to-balloon time was defined as the time from hospital arrival to the balloon inflation. Reperfusion strategy included thrombolytic therapy (TT) and primary percutaneous coronary intervention (PCI).

Statistical analysis

SPSS version 11.5 for windows was used for data analysis. Categorical variables are presented as the number of cases and percentages and compared using Chi-square tests. Time intervals are presented as median times (inter-quartile range, IQR). Non-parametric tests (Kruskal–Wallis H test) was used for comparison of time intervals between three groups. Other continuous variables are presented as mean $\pm$ standard deviation and compared by the Student's *t* test for comparison of two groups. All tests of statistical significance were two-tailed and probability values of $P < 0.05$ were considered significant.

Results

Baseline characteristics

A total of 803 patients with STEMI were enrolled. The mean age was 61 ± 13 yr (range 26–102), 22% were women and 42.1% were 65 yr old or older. More than half had a history of hypertension (50.4%) and current smoking (55.2%). Most of the patients (61.5%) reached the hospital in Killip class I. More than half the patients (54.2%) had anterior wall myocardial infarction (MI) at presentation (Table 1).

Reperfusion strategies

Among the 803 patients, 650 (80.9%) received reperfusion treatment: 124 (15.4%) were treated with TT and 526 (65.5%) with primary PCI. One hundred fifty-three patients (19.1%) did not receive any reperfusion therapy. The mean age was similar in the primary PCI (60 ± 12 yr) and TT groups (58 ± 11 yr), but was higher (65 ± 14 yr) in the non-reperfused group ($P < 0.0001$). Women accounted for 16.9% in TT group and 20.7% in primary PCI group, whereas in patients who did not receive reperfusion therapy, the proportion of women increased to 30.7% ($P = 0.006$). Compared with patients treated with reperfusion therapy, patients who did not receive reperfusion therapy were on average 5–7 yr older, were more often women, and

TABLE 1. Baseline characteristics

Variable	All Patients	T T	Primary PCI	No Reperfusion	P
Number (%)	803(100%)	124(15.4%)	526(66.5%)	153(19.1%)	
Socio-demographic					
Age (mean±SD, yr)	61±13	58±11	60±12	65±14	<0.0001
≥65 yr	338 (42.1%)	40 (32.3%)	215 (40.9%)	83 (54.2%)	0.001
Female	177(22%)	21(16.9%)	109(20.7%)	47(30.7%)	0.006
Health insurance	588(73.2%)	87(70.2%)	401(76.2%)	100(65.4%)	0.019
Cardiovascular risk factors					
Hypertension	405(50.4%)	54(43.5%)	265(50.4%)	86(56.2%)	0.127
Diabetes	160(19.9%)	23(18.5%)	98(18.6%)	39(25.5%)	0.071
Dyslipidemia	168(20.9%)	26(21.0%)	108(20.5%)	34(22.2%)	0.659
Family History of CAD	67 (8.3%)	13(10.5%)	44(8.4%)	10(6.5%)	0.420
Current Smoker	443 (55.2%)	85(68.5%)	295(56.1%)	63(41.2%)	<0.0001
Medical history					
Prior myocardial infarction	76(9.5%)	19(15.3%)	35(6.7%)	22(14.4%)	0.030
Prior angina	201 (25%)	36(29.0%)	115(21.9%)	50(32.7%)	0.017
Prior heart failure	14 (1.7%)	3(2.4%)	6(1.1%)	5(3.3%)	0.108
Prior stroke	83 (10.3%)	11(8.9%)	48(9.1%)	24(15.7%)	0.026
Admission parameters					
Killip class					0.875
I	494(61.5%)	82(66.1%)	320(60.8%)	92(60.1%)	
II-III	281 (35.0 %)	36(29.0%)	191(36.3%)	54(35.3%)	
IV	28 (3.5%)	6(4.8%)	15(2.9%)	7(4.6%)	
Heart rate (beats/min)	76±18	75±21	76±17	77±19	0.470
Systolic blood pressure (mmHg)	123±28	124±27	123±27	126±30	0.202
Diastolic blood pressure (mmHg)	76±18	75±17	76±18	77±17	0.565
Anterior wall infarction	435(54.2%)	69(55.6%)	275(52.3%)	91(59.5%)	0.15

CAD= Coronary artery disease.

P values are calculated between reperfused (PCI and TT) and nonreperfused patients.

had a higher prevalence of a previous history of myocardial infarction, angina and stroke, and were more likely to be those without health insurance.

In-hospital time delay

The median door-to-needle time in patients treated with TT was 83 min (IQR 55-135) and door-to-balloon time in primary PCI group was 132 min (IQR

98-183) (Table 2). Of patients treated with TT, only 7% of patients met the guidelines goal of door-to-needle time ≤ 30min, with 70% of patients being treated >1 hr after arrival at the hospital (Figure 1).

For patients treated with primary PCI, the door-to-balloon time, only 22% of patients had primary PCI performed in ≤ 90 min. The majority of patients

TABLE 2. Delay times

Delay times	All Patients (n=803)	Primary PCI (n=526)	T T (n=124)	No Reperfusion (n=153)	P
Symptom onset to admission	140(75,300)	138(70,300)	127(70,228)	190(93,365)	0.003
Door to needle			83(55,135)		
Door to balloon		132(98,183)			
Symptom onset to reperfusion		312(215,470)	240(155,360)		0.000

P values are calculated between TT , primary PCI and non-reperfused patients.

FIGURE 1. Door-to-needle time for patients treated with TT

FIGURE 2. Door-to-balloon time for patients treated with primary PCI

(57%) had >2-hour delay between arrival at the hospital and performance of primary PCI (Figure 2).

Pharmacological treatment

More than 97% of the patients received aspirin, whereas the use of clopidogrel and GP IIb/IIIa antagonists was largely influenced by the type of reperfusion therapy. Patients treated with primary PCI received clopidogrel and GP IIb/IIIa antagonists respectively in 94.1% and 22.4% of cases. About 92% received low molecular weight heparin (LMWH) and 30.3% unfractionated heparin (it is likely that, in some patients, the two drugs were used consecutively),

76.7% received β -blockers, and 73.5% received ACE inhibitors, as well as 91.0% received Statins (Table 3).

In-hospital outcomes

In-hospital mortality was 5.4% for the entire patient population, including patients without reperfusion therapy (Table 4). Although patients with primary PCI had a similar mortality rate to patients treated with TT (3.6% and 5.6%, respectively), the mortality rate for patients without reperfusion therapy was increased (11.1%; $P=0.001$). Women had a higher mortality rate than men (10.2% and 4.0%, respectively; $P=0.004$). Compared with patients <65 yr, the mortality rate for

TABLE 3. Use of medications during first 24 hr

Medications	All Patients (n=803)	TT (n=124)	Primary PCI (n=526)	No reperfusion (n=153)	P
Aspirin	785(97.8%)	123(99.2%)	514(97.7%)	148(96.7%)	0.386
Unfractionated heparin	243(30.3%)	67(54.0%)	148(28.1%)	28(18.3%)	0.000
Low molecular weight heparin	739(92.0%)	106(85.5%)	495(94.1%)	138(90.2%)	0.004
Clopidogrel	720(89.7%)	104(83.9%)	508(96.6%)	108(70.6%)	0.000
β -blockers	616(76.7%)	91(73.4%)	413(78.5%)	112(73.2%)	0.249
ACE inhibitors	590(73.5%)	89(71.8%)	393(74.7%)	108(70.6%)	0.534
GP IIb/IIIa antagonists	155(19.3%)	22(17.7%)	118(22.4%)	15(9.8%)	0.002
Calcium channel blockers	67(8.3%)	19(15.3%)	31(5.9%)	17(11.1%)	0.001
Statin	731(91.0%)	107(86.3%)	493(93.7%)	131(85.6%)	0.001

P values are calculated between TT, primary PCI and non-reperfused patients.

TABLE 4. In-Hospital outcomes

In-hospital Outcomes	All Patients (n=803)	T T (n=124)	Primary PCI (n=526)	No Reperfusion (n=153)	P
Length of Stay in CCU (Day)	6(5,7)	6(3,8)	5 (3,7)	6(3,8)	0.771
Death	43(5.4%)	7(5.6%)	19(3.6%)	17(11.1%)	0.001
Men (n=626)	25(4.0%)	4/103(3.9%)	12/417(2.9%)	9/106(8.5%)	0.031
Women (n= 177)	18(10.2%)*	3/21(14.3%)	7/109(6.4%)	8/47(17.0%)	0.106
< 65 yr (n=465)	9(1.9%)	2/84(2.4%)	5/311(1.6%)	2/70(2.9%)	0.749
≥ 65 yr (n =388)	34(10.1%) #	5/40(12.5%)	14/215(6.5%)	15/83(18.1%)	0.010
Re-infarction	13(1.6%)	3(2.4%)	9(1.7%)	1(0.7%)	0.491
Heart Failure	114(14.2%)	22(17.7%)	67(12.7%)	25(16.3%)	0.250
Stroke	3(0.4%)	1(0.8%)	1(0.2%)	1(0.7%)	0.491
Major Bleeding	18(2.2%)	2(1.6%)	11(2.1%)	5(3.3%)	0.602
CAVB	41(5.1%)	4(3.2%)	29(5.5%)	8(5.2%)	0.580
Atrial fibrillation	17(2.1%)	1(0.8%)	11(2.1%)	5(3.3%)	0.366
VT/VF	64(8.0%)	11(8.9%)	44(8.4%)	9(5.9%)	0.560

P values are calculated between TT , primary PCI and nonreperfused patients.

* = Mortality of women compared with men (10.2% vs 4.0%), $P = 0.004$; # = Mortality of patients ≥ 65 yr compared with < 65 yr (10.1% vs 1.9%) , $P=0.000$.

CAVB= Complete atrioventricular block. VT=Ventricular tachycardia; VF=Ventricular fibrillation.

patients ≥ 65 yr old was higher (1.9% and 10.1%, respectively; $P<0.001$).

The overall median length of stay in CCU was 6 (IQR 5-7) days for all patients. Comparing patients with TT, primary PCI and non-reperfusion, no differences in length of CCU stay were detected. Among all patients, 14.2% had heart failure, 8.0% had VT/VF, 5.1% had complete atrio-ventricular block, 2.2% had major bleeding, 2.1% had atrial fibrillation, 1.6% had reinfarction, and 0.4% had stroke during hospital course. All these complications were similar in patients treated with TT, primary PCI and patients without reperfusion (all P value <0.05).

Discussion

This is the first published study to reflect the pattern of care applied in the management of STEMI in real-life practice in a metropolitan Beijing, China. The important findings of this study are the higher rate of reperfusion therapy, good adherence to medical therapy and prolonged time delay to reperfusion in patients with STEMI in Beijing.

In the present study, 80.9% of patients with STEMI in Beijing received reperfusion treatment

(81% primary PCI; 19% thrombolysis). This represents a very high rate of reperfusion treatment, since our population included about 7% of patients with a pre-hospital delay > 12 hr and we also did not exclude patients with contraindications to thrombolysis. Meanwhile, it implies that primary PCI was the predominant reperfusion strategy in Beijing in the current reperfusion era. Lower rates of reperfusion therapy (thrombolysis 12%~52.5%, primary PCI 11.5%~48.9%) have been reported in previous studies reflecting real world practice on a nationwide scale of China.^{6,7} There was also a lower rate of reperfusion rate in some previous western registries. In the USIC 2000, 53% of patients with STEMI received reperfusion therapy (thrombolysis 28%, primary PCI 25%).⁸ In a contemporary Euro Heart Survey, 55% of patients received some form of reperfusion therapy, with 35% receiving TT and 21% receiving primary PCI.⁵ In the GRACE survey, 62% of patients with STEMI received reperfusion therapy, with 25% receiving PCI and 37% thrombolysis.⁹ In the BLITZ study, reperfusion rate was 65% in patients with STEMI (with a ratio thrombolysis / PCI of 3.4:1).¹⁰ However, the reperfusion rate observed in the present study are very close to those reported in the most recent surveys. The

reperfusion rate in the setting of STEMI in the ACOS registry increased over time, from 56% in 1994 to 73% in 2002. Reperfusion therapy in the NRMI study increased from 64% in 1994 to 72%, favouring primary PCI in 2004.¹¹ Results from the Vienna STEMI registry showed that implementation of guidelines resulted in increased numbers of patients receiving reperfusion therapy (from 66% in 2002 to 86.6% in 2004), and primary PCI usage increased from 16% to almost 60%.¹² Therefore, with respect to the reperfusion rates in patients with STEMI, there remains considerable variation in clinical practice from country to country and from region to region, as well as from time to time.¹³ Several advantageous factors may contribute to the higher reperfusion rate observed in the present study. First, in Beijing, the capital of China, patients have a high level of education and are willing to make decisions on receiving reperfusion treatment. Second, there exists a comprehensive health insurance coverage in Beijing, so most of patients can receive the best available treatment. Third, all secondary and tertiary care centres in Beijing have already created critical pathways which can provide primary PCI around the clock, and Chinese interventional cardiologists frequently prefer primary PCI irrespective of the times to balloon inflation. Finally, there was widespread transmission and implementation of guidelines for STEMI in Beijing. Therefore, it is not surprising that primary PCI was already the most widely applied type of reperfusion in patients with STEMI in Beijing. Guidelines recommend that door-to-needle time should be < 30 min and door-to-balloon time < 90min.² Disappointingly, the present study showed that door-to-needle time in patients treated with TT was 83 min, door-to-balloon time in primary PCI group was 132 min, and only 7% of patients receiving thrombolysis met the guidelines goal of ≤ 30 min, as well as only 22% of patients had PCI performed in ≤ 90 min. These figures are substantially longer than those of other studies. Door-to-needle-time was 59 min in the ESC survey,⁵ 45 min in the BLITZ study,¹⁰ 38 min in NRMI-3,¹⁴ 32 min in the AMI-QUEBEC

Study¹⁵ and 17 ± 13 min in the Vienna STEMI Registry.¹² Door-to-balloon-time was 85 min in the BLITZ study,¹⁰ 111 min in GRACE,⁹ 108 min in NRMI-3,¹⁴ 93 min in ESC survey,⁵ 81 ± 51 min in the Vienna STEMI Registry,¹² 109 min in the AMI-QUEBEC study.¹⁵ In TIMI 9 Registry, 20% of patients treated with TT met the goal of ≤ 30 min, and 30% had PCI performed within 90 min.¹⁶ In the AMI-QUEBEC Study, almost half of the patients (48.8%) received thrombolysis within 30 min and 35.5% of patients received primary PCI within 90 min.¹⁵ A more recent study from the NRMI showed that 46% of patients in the fibrinolytic therapy cohort treated within the 30-min goal, and 35% of the patients for PCI met the recommended ≤ 90 -min door-to-balloon time.¹⁷ In the present study, pre-hospital delay for the entire patient population was 140 min. Similar pre-hospital delays were observed in the BLITZ study (median 110 min)¹⁰ and GRACE (139 min).¹⁸ Longer pre-hospital delays were observed in ESC survey (176min),⁵ Vienna STEMI Registry (180 ± 156 min),¹² TIMI 9 Registry (6.3h),¹⁶ and the USIC 2000 (5.0h).⁸ Longer in-hospital delay in the present study might be explained by patients or their relatives having a long time to make decision on receiving reperfusion treatment, patient characteristics, or hospitals characteristics etc.

The present study confirms the very high use of evidence-based drugs such as aspirin, LMWH, clopidogrel and statins during hospital stay. It is striking that, despite evidence of the benefit of glycoprotein IIb/IIIa antagonists in STEMI,^{3, 19} they were used in only a minority of patients. Even in patients who underwent primary PCI, the use of glycoprotein IIb/IIIa antagonists was as low as 22.4%. In patients treated with TT, the percentages were 17.7%, and only 9.8% of patients without reperfusion therapy received glycoprotein IIb/IIIa antagonists. Possible explanations may include its high cost which is covered by medical insurance.

Beta-blockers and ACE-inhibitors were slightly less prescribed (76.7% and 73.5% respectively) in the present study, consistent with previous reports,^{5,9,10}

and higher than observed in TIMI 9 Registry (Beta-blockers used in 61%, and ACE-inhibitors used in 13% of patients).¹⁶ In this survey, in-hospital mortality was higher in women (10.2%) than in men (4.0%), and higher in elderly patients ≥ 65 yr (10.1%) than in patients <65 years (1.9%), mostly due to their greater co-morbidity. The overall in-hospital mortality was 5.4% in the present study, similar to that observed in a recent study (4.0%)²⁰, and somewhat lower than observed in the BLITZ study (7.5%),¹⁰ in the USIC 2000 (9.3%),⁸ in Vienna STEMI Registry (9.5%),¹² in ESC survey (7.0%),⁵ and in GRACE (7%).⁹ Lower in-hospital mortality in the present study may be due to the high rate of reperfusion therapy and particularly of primary PCI.

Two limitations of the study need attention. First, an unmeasured bias may have been introduced with respect to the selection of participating medical centres. The results of this survey should therefore not be generalized to all medical centres within Beijing. Moreover, this figure does not take into account the number of patients with STEMI who died before admission to CCU or those admitted >24 hr after the onset of symptoms. Nonetheless, this study is the largest survey of acute STEMI hitherto in Beijing, providing a basis for future surveys, which may be more comprehensive and representative. A central insight from our study is the higher rate of reperfusion treatment and prolonged door-to-treatment times. The more compelling question is how optimal reperfusion can be best achieved in STEMI within the guidelines-recommended time. A number of systems or networks have been developed to improve the acute care of STEMI patients in developed countries.^{12,21,22} Our challenge now to provide optimal STEMI care needs to be solved at 2 levels: prolonged pre-hospital delay and in-hospital delay. First, future efforts are needed to educate the public on awareness of symptoms of AMI in order to reduce pre-hospital delay. Second, it may be imperative to create collaborative, interdisciplinary teamwork and patient-focused organizational culture in order to improve in-hospital delay in

patients with STEMI. In addition, it will be helpful for reducing door to treatment time to establish the social security fund of first aid for the poor patients. We believe that this registry study will provide a foundation for improving the acute care of STEMI in the future in Beijing, China.

In conclusion, Clinical guidelines recommended treatments are largely implemented in patients with STEMI in Beijing. However, many patients were not reperfused within the recommended times. There remains important potential for improvement in the administration of reperfusion therapy.

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